

Campbell 2 of 9
(1-28)

Wells who wants
to go to the
North Pole, I want
people to subscribe
to buy a ship.

Feb 2. 1873—

When you write

~~to go to the~~

on the 10th + 11th

to go to the

to go to the

Feb 2. 1873.

Hiddry Lodge,
Kensington.

My dear Sir

I return your papers
with some marks in
Red pencil ~~as the~~

marginis. If I were
getting up a subscriber
I would avoid attacking
Theorists and stating
and say as little about
Theories. ~~My own Theory~~
Science is possible.
Opinion has always
my Theory

ature at great depth. On July 12th, when in 60 fathoms, a
vessel was fixed in the ice, the temperature gradually increased to 64° F.
at a depth of 600 fathoms. These facts indicate the southward flow of
vast body of warm water. It cannot be said that the heat is derived
from the Gulf-stream, because nowhere in its course, even in such lati-

no Sir

This indicates that the ^{salt} equatorial current
does not make the ice ^{fresh} separate at 33° F

been that the best
chance of getting to
the North Pole is to
follow the Equatorial
^{North East}
Current. ~~I suppose~~
~~that~~ ice grows

on the ~~Polar Basin~~
in winter
streams on the edge
of it, and escapes
S. ^{the} West
by ~~the~~ openings in

by Greenland or by Asia

it? In so doing

it ^{probably} leaves an
open space, ^{in the middle of summer} a

gap may possibly
^{into open water} work through some
~~opening~~ ^{line} in the spreading

ice, ~~which~~ is

~~slowly~~ moving out
of the basin
away from the

^{mechanical}
Pile for reasons
which I shew you

perature at great depth. On July 12th, when in $80^{\circ} 17' N.$, and when the vessel was fixed in the ice, the temperature gradually increased to $64^{\circ} F.$ at a depth of 600 fathoms. These facts indicate the southward flow of vast body of warm water. It cannot be said that the heat is derived from the Gulf-stream, because nowhere in its course, even in such lati-

This indicates that the ^{salt} equatorial current

NO 5

This day, in a ~~month~~
~~hour~~ between Greenland
my version. I strongly advise
And Spitzbergen
you to revise your pamphlet
before you show it to the
~~public~~ ~~public~~. It needs editing.

No coin to spare
were luck
And I am too old

to go myself, but
I think that you are
on the right track
& I wish you ^{to success} ~~luck~~

I am
Yours very truly
J. H. Campbell

Observations on the Temperature of the Arctic Sea in the neighbourhood of Spitzbergen. By JOHN C. WELLS, Capt. R.N.

WHILE almost every other nation is making its effort to promote scientific discoveries in the high latitudes of the north, England remains inactive.

My object in addressing the following remarks to the Royal Society is to bring to its notice the voyages of the 'Samson' yacht, and to direct attention to some points on the temperature of the Arctic Sea, to which access is obtained through the broadest gateway to the north, *i. e.* that between Greenland and Norway, the portal of which is guarded by Spitzbergen. In the western portion, along the coast of Greenland, it is more or less blocked with ice, and the water is cold. In the eastern part, in the vicinity of Spitzbergen, there is warm water and an open sea at certain seasons of the year as far north as 81° , and in some years one or two degrees further. Nearly all the discoveries in these regions have been made by persons engaged in commercial enterprise; so that, even when favourable opportunities offered, their interests restrained them from taking advantage of the same.

In 1871 Mr. B. Leigh Smith made a cruise in his schooner yacht 'Samson,' and reached $81^{\circ} 24' N.$, with an open sea before him, comparatively free from ice. The pack-ice was drifting southwards, and the water at the surface was $33^{\circ} F.$, while at 300 fathoms it was $42^{\circ} F.$ This fact was observed by Capt. Scoresby in lat. $78^{\circ} N.$, $0^{\circ} 10' W.$, surface $32^{\circ} F.$, and at a depth of 760 fathoms $38^{\circ} F.$ In 1872 a second cruise was undertaken, in which I had the pleasure of accompanying Mr. Smith. On this occasion the sea was crowded with ice, and the ship was beset. The ice had evidently required more than one year for its formation; its surface was covered with opaque snow, and was generally flat, and in no case rose higher than the gangway of the little schooner.

Owing to the floes presenting a comparatively smooth surface, with a total absence of icebergs, we were led to form the opinion that no land can exist in the vicinity immediately north of Spitzbergen, as the southerly drift would be sure to bring down floating bergs, which are always formed in the valleys of northern land.

On this occasion observation with the Miller-Casella thermometer confirmed the result of the previous year, *viz.* gradual increase of temperature at great depth. On July 12th, when in $80^{\circ} 17' N.$, and when the vessel was fixed in the ice, the temperature gradually increased to $64^{\circ} F.$ at a depth of 600 fathoms. These facts indicate the southward flow of vast body of warm water. It cannot be said that the heat is derived from the Gulf-stream, because nowhere in its course, even in such lati-

*This indicates that the ^{Salt} equatorial current
dived under the ice & ^{float} water at $33^{\circ} F$
its least density.*

No Sir

The
whole
Carpenter
current.

tudes as 50° or 60° , does it acquire so high a temperature, even at the surface; and it is highly improbable that the general warmth of the ocean along the west coasts of North Europe, on the shores of Norway, could possibly be supplied by the limited body of warm water which leaves the Gulf of Florida. If the whole of the Gulf-stream water were spread over the warm-water area in the north, its depth, even allowing the most liberal estimate for its volume, would not exceed 10 fathoms; whereas warm water of 42° F. occurs to the depth of 400 fathoms in this region, and north of Spitzbergen it is found as high as 64° F. at 600 fathoms. If it be said that this temperature is due to the northward drifting of the Atlantic from warmer localities, we are met by two difficulties, of which one is, that the soundings obtained by Carpenter and others gave temperatures much below 64° , and the other is, that the waters flow south, not north. Volcanic action, or a warm mineral spring rising from the ocean-bottom, may by some be imagined to be the cause of the temperature of 64° ; but there is no evidence of either of these agencies, and it is quite reasonable to suppose any other feasible cause. Passing over the discovery of 64° F. at this depth, we still have to account for the water of 42° F. flowing southwards, as evidenced by the increase of its temperature as we proceeded northwards.

That
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It is clear that this question of temperature requires further investigation; and it is also clear that whatever the result may be, it will materially affect all the prevailing theories respecting oceanic currents. It is not improbable that this warm water flows from the circumpolar region; and if so, it would indicate a circumpolar sea.

10.
that
give

Many facts are known which are consistent with this view. Every year the edge of the pack-ice, and the ice-fields themselves, break up and drift south, at a rate sometimes equal to thirteen miles a day, as found by Capt. Parry. This does not occur when the northern ocean is wholly covered with ice, in the winter season. The drifting of the ice (as also currents) implies a sea free of ice somewhere in the north, occupying an area at least as extensive as the drift-ice. As has been seen, some of the ice is the result of more than one year's growth; and as the ice travels southerly, say, from four to thirteen miles or more per diem, a similar area of open sea must be simultaneously forming round the pole, the ice-holes and clear spaces in the drift-ice being quite insufficient to make up for the space left by the ice during the summer. The great abundance of animal life in the waters of the highest latitudes reached indicates that the water is not ice-cold; and the migration of numerous species to the north of 80° shows that the means of subsistence can be obtained. There is reason to believe that whales occur far to the north of 80° ; and if so, there must necessarily be sufficient open water to allow of their finding ready access to air.

In the Spitzbergen seas a blue, cloud-like appearance is well known as a sign of open water; and this has been seen on the distant north horizon

on Sunday Feb. 2. 1873. The author did not know that water at 40° is heavier than water at 33° .

even by ships which have been beset by ice in the highest latitudes. Icebergs, it is well known, waste more rapidly below the surface than in the air, causing them to topple over frequently, obviously the effect of the warm current.

The question, then, is, from whence do the warm waters come? and how do they acquire their heat? And this is one of the questions which a polar voyage by way of Spitzbergen would almost certainly elucidate. Another important subject of investigation would be the conditions under which the prevalent north winds of high latitudes originate. There is one argument bearing upon the temperature of the circumpolar seas which should not be overlooked. During six months of the year the sun is above the horizon; and although the rays may be oblique, still the waters may acquire a higher temperature than under similar conditions further south, owing to there being little or no cooling from nocturnal radiation, and probably to the constant dryness of the air allowing the sun to strike with full power. During the winter these causes would intensify the cold.

The occurrence of warm water is by no means confined to the sea around Spitzbergen; but, before referring to other regions, we may mention that a set of instruments for taking soundings and deep-sea temperatures was supplied this year by Mr. Smith to Capt. David Grey, of the whaler 'Eclipse,' whose father, in the year 1855, supplied the valuable information and survey of the extension of Pond's Bay, now called Eclipse Sound. His observations were made in the middle of the sea, between Greenland and Norway, and along a line running north-easterly from Iceland. They coincide with Dr. Carpenter's observations, proving the termination of the Gulf-stream. In June 1854 Morton advanced beyond Kennedy Channel, and saw open water as far as the horizon, visible from a hill 500 feet high. The wind was from the north-west, and a rain-cloud was seen in the distance above the open sea. The water was setting in a strong current south, and the ice along the shores was in a rapid state of dissolution. The water was found in the several places tried to be well above the freezing-point; and in one place, some distance from the ice-foot, and at a depth of 5 feet, the temperature was 40° F. There was a strong tide from the north. Kane's vessel wintered in Renselaer Harbour; the strait was bridged across by ice, with a current running south flowing beneath it. Although the open waters above alluded to may not be direct evidence of a comparatively mild circumpolar region, yet the stream of warm water coming from the north seems to indicate it.

Where can this water acquire its warmth? Sir John Richardson suggests that it is derived from the warm area near Spitzbergen; but this is not supported by evidence, which indicates that in both areas the water comes from the north. It has been suggested that it is a continuation of the Gulf-stream, apparently because it is supposed to supply all the warm water in the Arctic seas; but if there is no reason for believing that the warm sea around Spitzbergen derives its heat from this source, it is still

*ice & the light surface water is but the
heavier & warmer water below is going north
I think the author says so.*

Egypt

*Iceland
that it
is coming
from
the
north
The*

less credible in the case of the Kennedy-Strait water. It has been suggested that the source of warmth is the northward flow of the general mass of the North Atlantic. If this did account for the warmth of the Spitzbergen area, although this view would be with difficulty reconciled with a southward flow of Arctic water, it would be quite inapplicable to the Kennedy-Channel area.

Temperatures taken by Mr. B. Leigh Smith and Capt. Wells, R.N.

1872.	Station.	Lat.	Long.	Depths in fathoms.	Temperature.			
					Air.	Sur- face.	Min.	Max.
June								
1.	1.	68° 52' N.	6° 40' W.	600	42	37½	30	37½
13.	2.	75° 6' N.	2° 30' W.	100	36	31	28	35
15.	3.	75° 7' N.	3° 48' W.	100	36	32	28	35
				50	...	31	29½	32½
17.	4.	76° 13' N.	2° 22' W.	100	34	31	29½	34
18.	5.	76° 3' N.	0° 10' E.	150	35	33	30½	40
				200	...	33	30½	48
19.	6.	76° 21' N.	1° 5' E.	150	35	32	30½	32
				250	...	32	30½	39½
20.	7.	76° 35' N.	0° 3' W.	6	34	33	30	33
				25	...	33	30	35
				150	...	33	30	39½
22.	8.	76° 41' N.	2° 10' W.	150	35	32	29½	39½
27.	9.	77° 18' N.	5° 0' E.	25	37	34½	32	34½
				250	...	34½	32	39
July								
1.	10.	78° 20' N.	7° 2' E.	6	36	36	33	36
			"	600	...	36	33½	36½
6.	11.	79° 54' N.	6° 34' E.	6	35	34½	33	34½
				12	...	34½	33	35
				25	...	34½	33	37
				50	...	34½	33	37
				200	...	34½	33	40
				Bottom				
7.	12.	80° 4' N.	5° 12' E.	600	37	34½	31½	39
10.	13.	80° 23' N.	9° 0' E.	12	35	31	28	31
				50	...	31	28	31½
				Bottom				
12.	14.	80° 32' N.	9° 50' E.	600	36	31	28½	64

This proves that which necessarily
occurs from the density of,

The
author
seems
to be
entirely
ignorant
of the
fact of
upper &
lower
opposite
currents
shown
to him
in my
treatise
on Sunday
Feb 3
1873

Among the many advantages that would result from circumpolar research and the following up of this warm current, not the least important would be the insight which it would probably afford as to the regulating influences of the weather of North Europe, or generally of the northern hemisphere. Meteorologists have long suspected that the weather in Western Europe depends in some way upon what has happened in the vicinity of the pole. The many advantages to be gained to science by circumpolar navigation cannot be doubted. Among them would be careful observations of the currents and temperatures of the surface and at various depths, and organisms which doubtless would be obtained by dredging, as far as practicable, in the bed of the Arctic Sea, in the highest latitude, and the probable extension of the whale-fisheries, as well as the discovery of new land, should such exist.

June 1.—The edge of the ice was 170 miles distant, and the warm water was found at the surface, and cold water, which is of greater density, below.

June 13.—The sounding was taken at the edge of the pack. If the experiments had been continued, increasing temperature would probably have been found at a lower depth, as was the case further north.

June 15.—To-day we were well in the ice, and had only time to sound in 50 fathoms; but even here we found an increasing temperature.

{ 38
40

June 17.—Being far in the ice, we only found a slight increase.

June 18.—A second sounding, 50 fathoms deeper than yesterday, when sailing among large pieces of floe-ice, gave an increasing temperature up to 48° F.

June 19.—To-day we had an increase of 7° above the surface-temperature at 250 fathoms deep, although but 10 miles distant from yesterday's soundings; but the ice was more open: probably evaporation occurred here, owing to the surface not being so closely covered with ice.

June 20.—The first sounding shows the water to be coldest at the ice-foot; the second and third prove the increasing temperature, which, as we were somewhat more closely packed in the ice, increased more quickly, and 39° F. is obtained at 150 fathoms deep.

{ 33°
39

June 22.—Here we were more closely packed. The surface was a degree colder than yesterday, and the water at the ice-foot had also gone down half a degree; but the warm stream below was the same. If we had had time to sound at greater depths, the temperature of the water would in all probability have been found still on the increase.

June 27.—In this case we have the warm current clearly defined at 250 fathoms depth, being kept below by the lighter ice-water, which is nearly fresh and of less specific gravity.

{ 34 1/2
?

July 1.—We were clear of the ice, and had a lower temperature than before obtained. If the flow of warm water came from the south, the surface-temperature would have been greater than any temperature as yet obtained, because of the absence of ice.

This is all Bosh — JF

July 6.—This observation shows a gradual increase as far down as 200 fathoms. We were well in the ice, and were prevented from continuing our sounding-operations. Little evaporation has taken place, owing to the closeness of the ice and the gradual increase of the temperature, with one exception, which occurred on the 18th of June, when a temperature of 48° was obtained,—showing that the temperatures are materially affected by local causes, the closeness of the pack or the opening of the ice allowing evaporation to take place.

July 7.—Here, where the ice is close, there is a great difference between the surface temperature and that at the ice-foot. We pulled up a very beautiful description of starfish, which would not be likely to inhabit this warm current were it of volcanic origin.

July 10.—The crew being required elsewhere, we could not continue our sounding-experiments. The sounding shows a decrease of temperature, owing to the ice-water.

July 12.—This remarkable sounding was carefully registered specially by Mr. Smith, who saw the index before it was immersed and immediately on its coming up. This shows a gradual increase of temperature towards the north, proving the current to come from the north; and its temperature being above that of the Gulf-stream, where it disperses itself, is a proof it is in no way connected with it.

The thermometer has since been examined by Mr. L. P. Casella, who certifies that it "has been tested in the hydraulic press, as well as carefully compared with my standard, and found correct in every way, no change whatever having taken place in the instrument."

31°

64° .

32. Fresh water freezes

26 { Salt water freezes,
exhibits the salt &
blunts as ice.

37 Greatest density
of water. Fresh

But Concentrated
brine would sink
below fresh water
at 37° . Though it
 64° was at the observed
temperature.

Temperatures taken by Capt. David Grey, of the 'Eclipse' Whaler.

1872.	Station.	Lat.	Long.	Depths in fathoms.	Temperature.			
					Air.	Sur- face.	Min.	Max.
April 13.	15.	68° 45' N.	13° 58' W.	220		29°	28·8	32°
15.	16.	68 52 N.	15 40 W.	220		29	29	31·5
20.	17.	68 12 N.	16 40 W.	270		28·8	28	31
May 14.	18.	75 0 N.	16 20 E.	85		29	29	32
June 6.	19.	78 20 N.	0 20 E.	400		30	30	33
8.	20.	78 14 N.	0 18 W.	220		30	29	30
				400		30	30	32
18.	21.	75 5 N.	6 15 W.	400		32	29·5	32
				200		32	30	32
23.	22.	74 50 N.	6 50 W.	100		32	30	32
				400		31	30	32
July 3.	23.			200		34	30·5	34

April 13, 15, 20.—When these three soundings were taken the ship was frozen in the pack; still there is a slight increase of temperature at the lowest depth.

May 14.—Off Bear Island.

June 6, 8.—Here 'Eclipse' was 75 miles inside the pack.

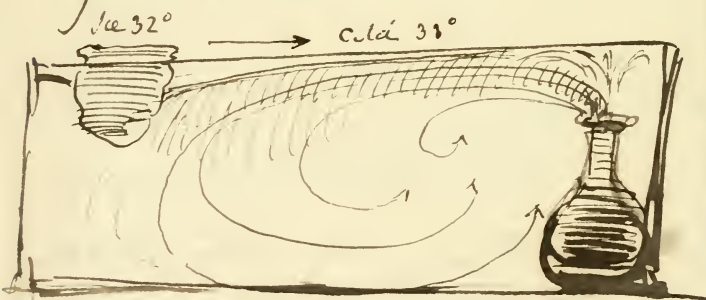
June 18, 23, July 3.—Made fast to a large floe, about 90 miles inside the pack.

*I see nothing in this paper
to alter any single idea
that ever entered my head
on this subject much to
prove that science is
science*

and funny funny.

In my tank this morning
Wednesday 5th There
is a layer of clear cold
water above the black
mud. And so there
was while I was showing

my experiment to



Wells & Ramsay. —

Feb 5. 1873.

J. H. Campbell

Feb 3rd 1873
Southborough
Bickley
Kent.

Dear Mr. Campbell

I am very much obliged
to you for the remarks &c.
you have made on my paper.
I shall follow your advice,
and make up the pamphlet
with the whaling Captains
evidence ^{only} and bind it up
with the probable discoveries
that might be made.

Among them the possibility
of defining the climate.
Le,

I am now getting up
a committee and then
I shall put the
prospects in the times
and send the
paper to different libraries,
Wm. & Mary. —

Feb 5. 1873.

J. R. Campbell

men who I hope will
respond to it.

(I should very much
like to get you to act
as a committee man,
because you could then
inform the Duke every
thing that was going
on. Then shall not
be much for you.

To no. I am ~~excused~~.

W. anxious to get such
✓
✓ as yourself who are
✓ well known.

Yours very truly,
M.

Private & W. L.

I did not expect the
to be to subscribe and
wish I could manage
to do that for him
& still retain his name

Wm. ...

Feb 5. 1873.

J. H. Campbell

